LabVIEW Code Security

NI Test System Security Summit

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Aerospace & Defense Business Unit

NI

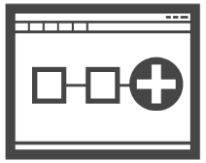
Meeting NIST 800-53 Controls

System owner must demonstrate that:

The organization requires the developer of the information ***system***, system ***component***, or information system ***service*** to…<meet the controls>

On a deployed LabVIEW System, this means:

Information storage



User-developed code

This presentation

LabVIEW Run-Time Engine
Drivers

Hardware

Meeting NIST 800-53 Controls

“The information system enforces policy where a subject that has been granted access to information can pass the information to any other subjects or objects; grant its privileges to other subjects; change security attributes on subjects, objects, the information system, or the information system's components; choose the security attributes to be associated with newly created or revised objects; or change the rules governing access control.”

“The information system does not release information outside of the established system boundary unless the receiving system or system component provides defined security safeguards; and security safeguards are used to validate the appropriateness of the information designated for release.”

“The organization requires the developer of the information system, system component, or information system service to identify early in the system development life cycle, the functions, ports, protocols, and services intended for organizational use.”

“The organization requires the developer of the information system, system component, or information system service to employ static code analysis tools to identify common flaws and document the results of the analysis.”

LabVIEW Code Security

Agenda:

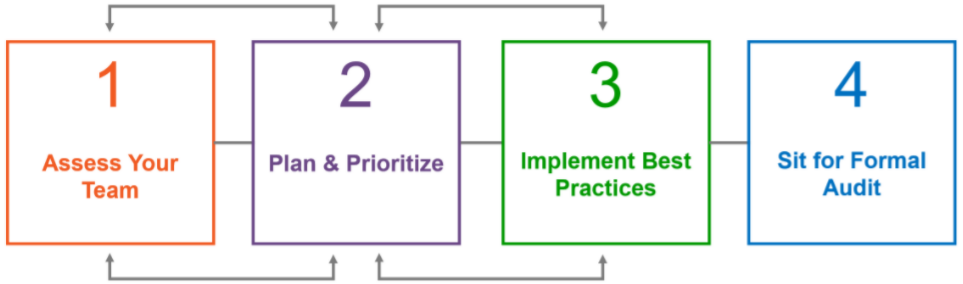
1. Develop quality code
2. Protect code development
3. Verify code performance
4. Validate code usage

Develop Quality Code

LabVIEW Center of Excellence

ni.com/lvcoe

NATIONAL INSTRUMENTS | CENTER OF EXCELLENCE



Software standardization and success...

... entails more than ensuring a team uses the same software tool. Your team should be implementing consistent and proven software practices. Three pillars of expertise are essential for ongoing success: Engineer Good Software, Engage in Community Learning, and Ensure Technical Leadership. These practices include ensuring that your architecture aligns to your application, that you have onboarding and appropriate training for your team, and the you implement software engineering processes that fit your workflow. Those teams that incorporate these best practices and choose to sit for and subsequently pass the CoE audit are awarded Center of Excellence Certification. Twelve teams world-wide enjoy this elite honor.

ASSESS YOUR TEAM

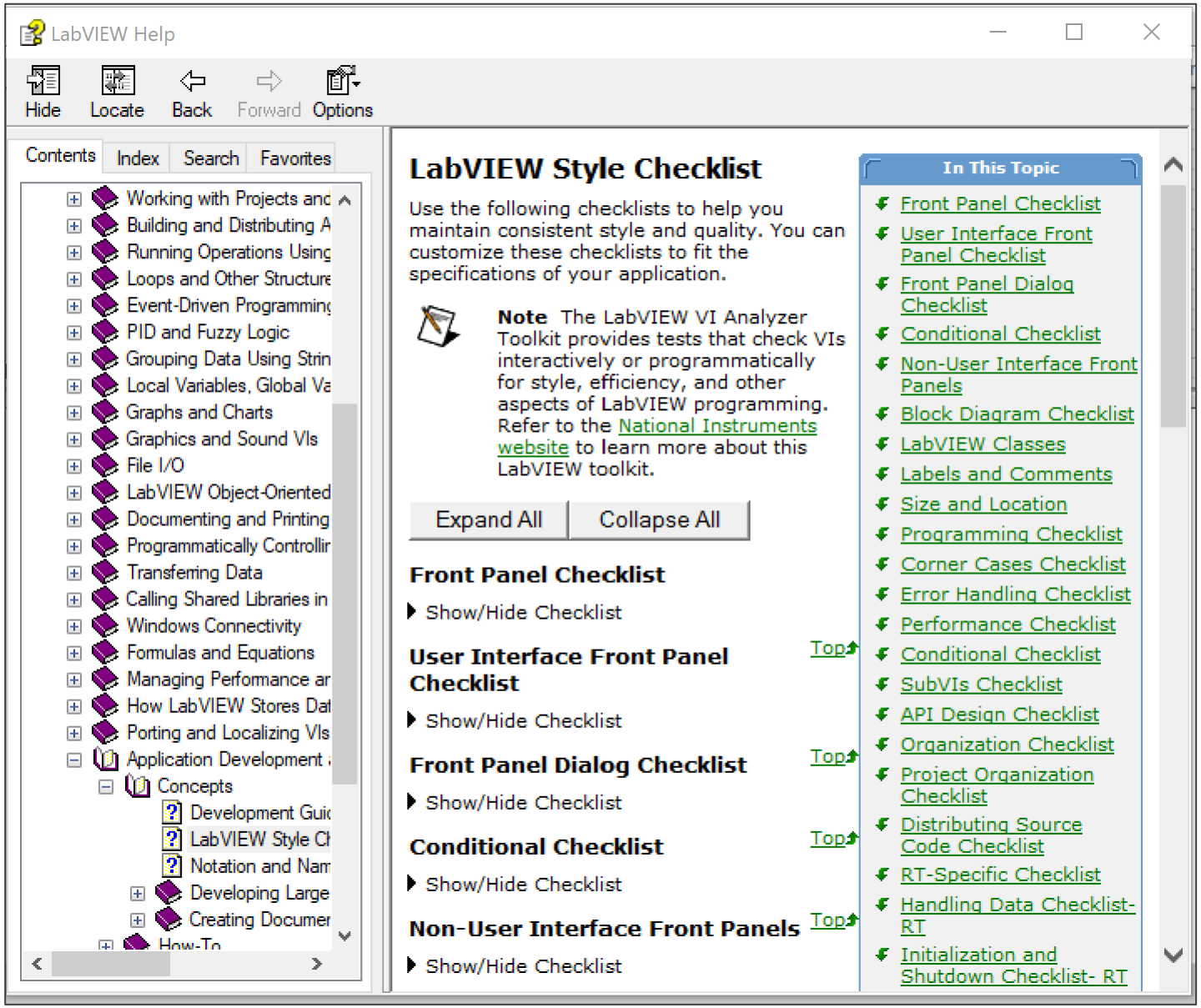
PROGRAM OVERVIEW | ENSURE TECHNICAL LEADERSHIP | ENGAGE IN COMMUNITY LEARNING | ENGINEER GOOD SOFTWARE

LabVIEW Style Guide

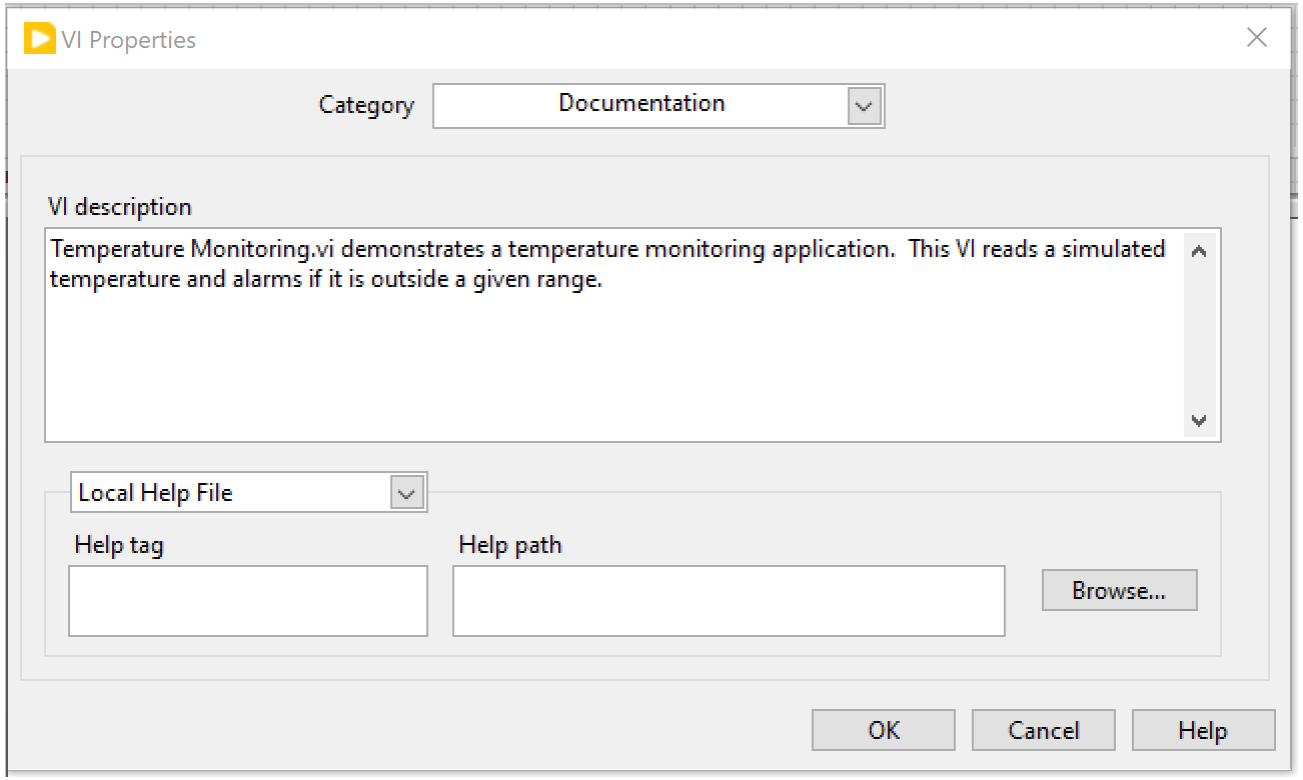
Included in LabVIEW Help for each version
Tips to develop readable code
Checklists to ensure compliance

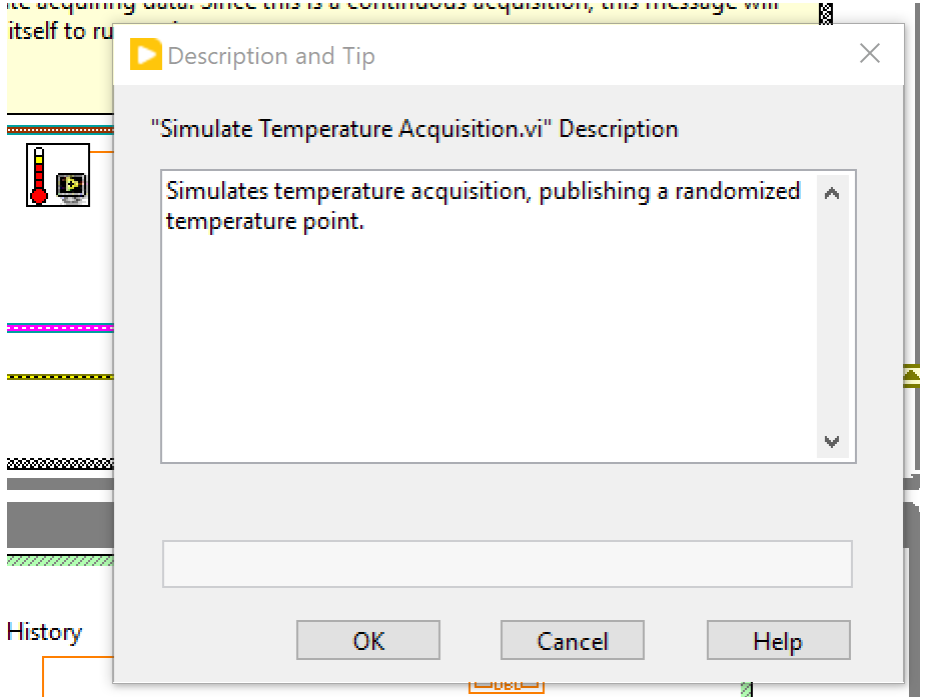
Develop your own style guide

Style – Object-oriented, Actor Framework?
SubVI terminal wiring standards
SubVI documentation and icons
Documentation guidelines



Document LabVIEW

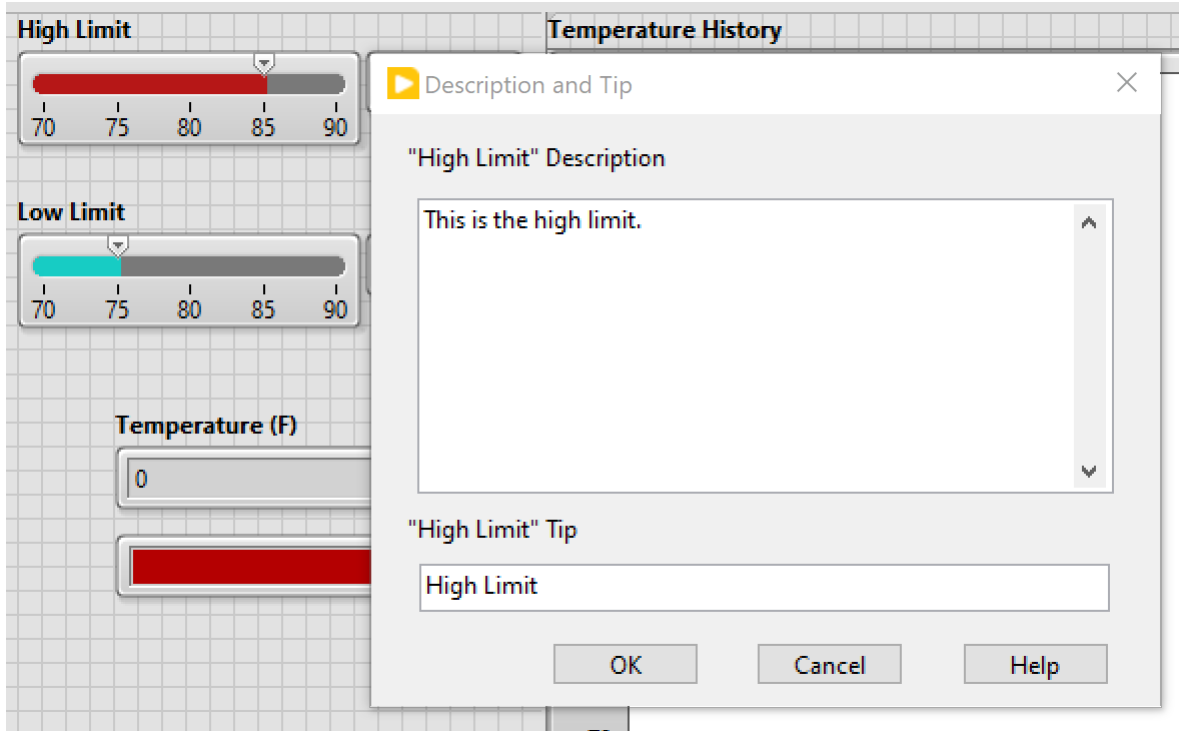


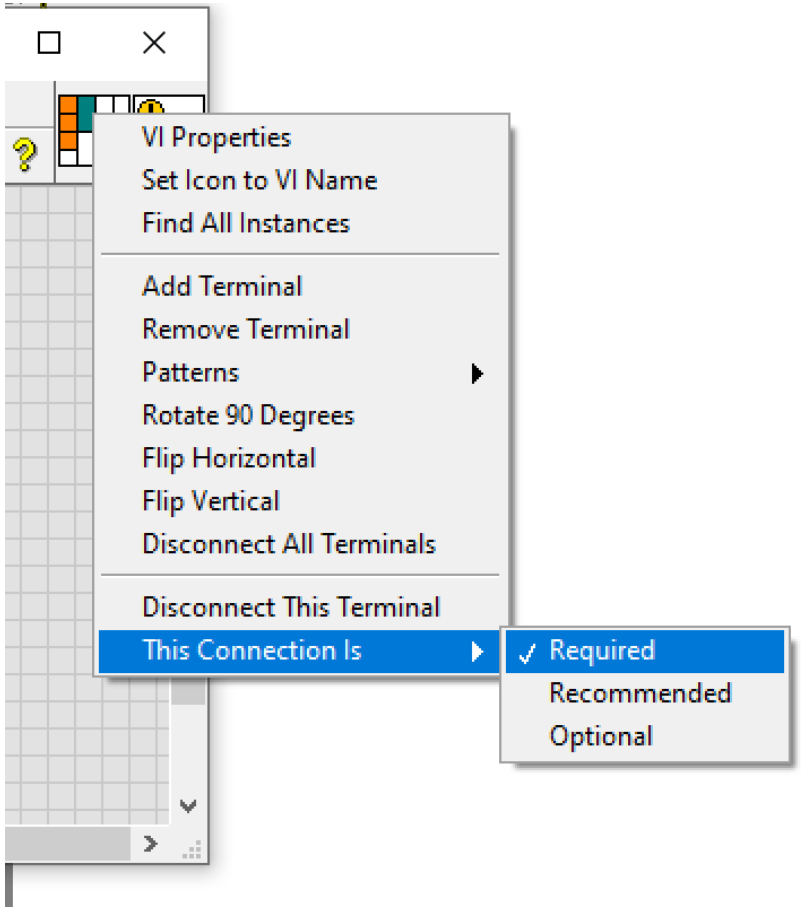


VI Properties…Documentation
Overall VI Description
Appears in all uses of the VI

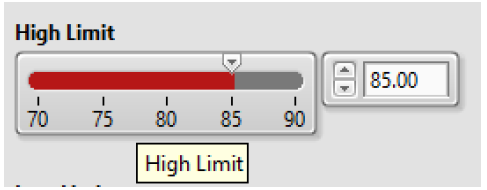
Right-Click…Description and Tip…
Appears only in that usage of the VI

Document LabVIEW



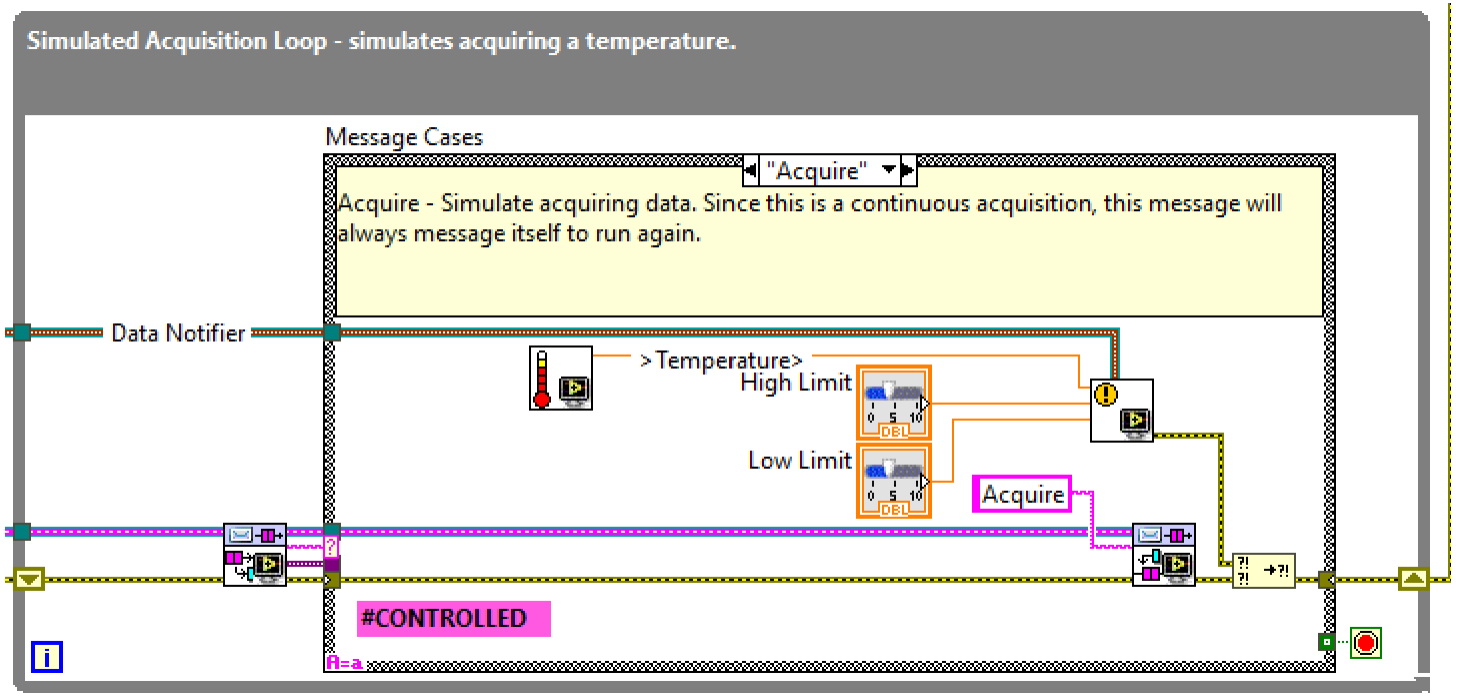


Control…Right Click…Description and Tip
Description appears in VI Documentation
Tip appears in mouse-over



Terminals…This Connection Is…
Required
Recommended
Optional (Consider impact of using defaults)

Document LabVIEW



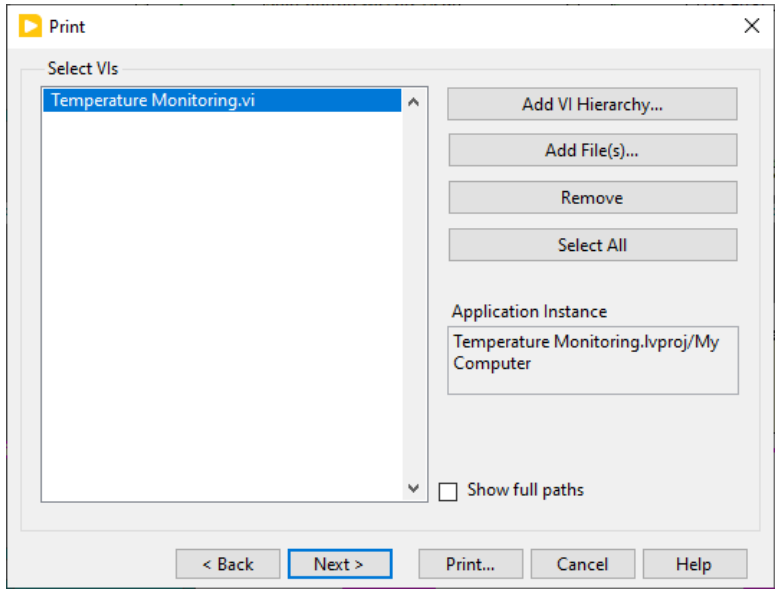
Visible Items…Labels

VIs, Functions, Wires, Loops

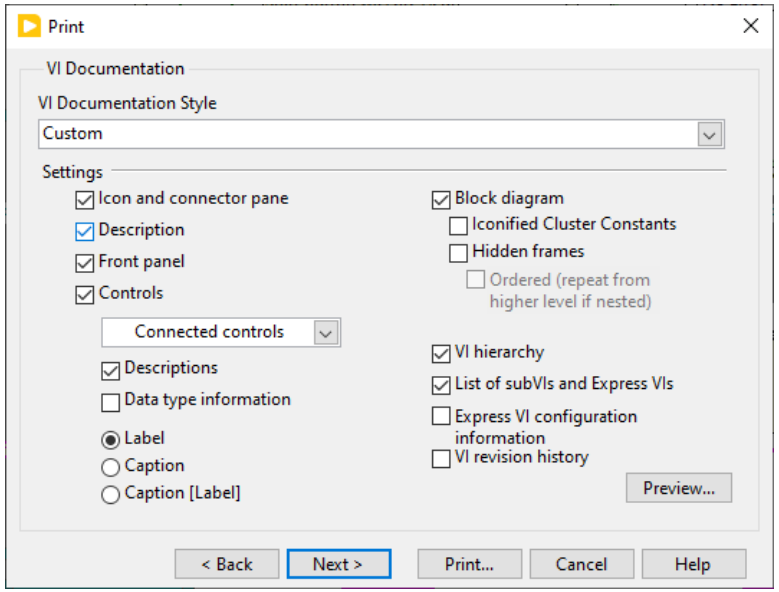
Use special labels to identify restricted code

Generate LabVIEW Documentation

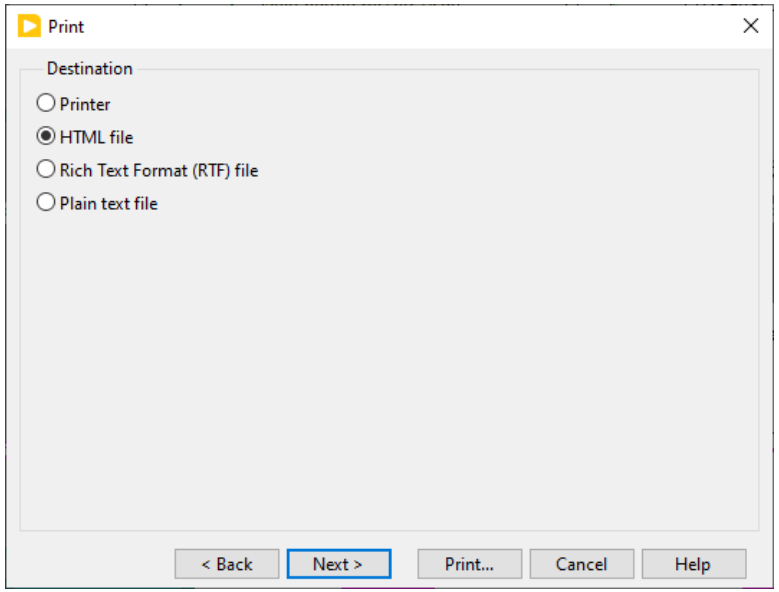
File…Print…VI Documentation…



Select Add VI Hierarchy for complete code



Set options for detailed documentation



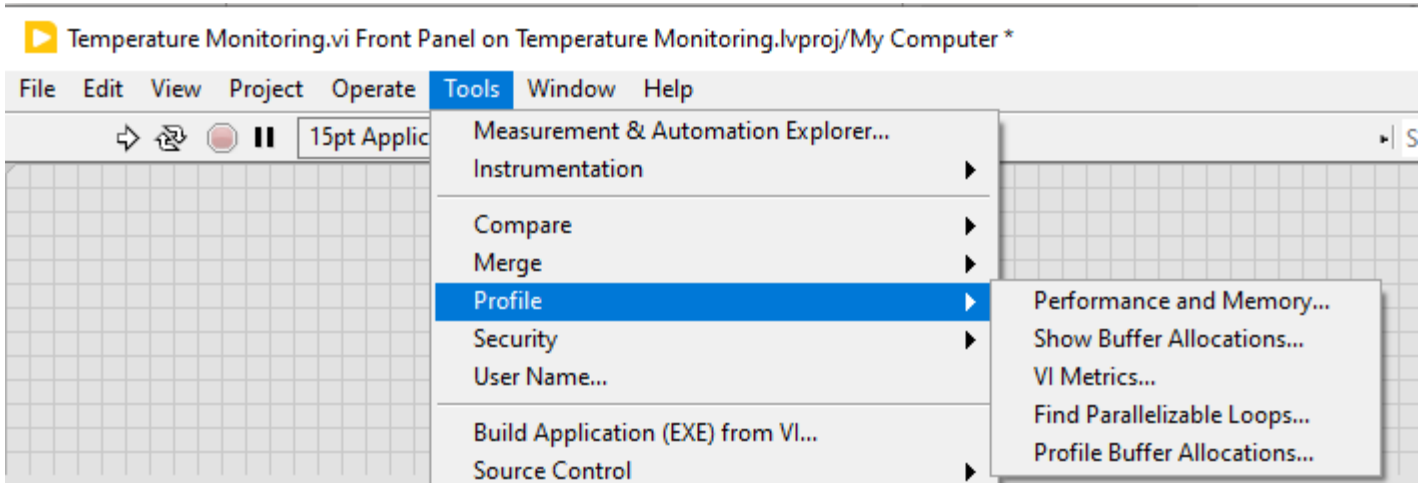
Printer – Print to .pdf
RTF – Generate single editable document
HTML – Generates folder with images

Block diagrams, Front Panel of each VI and SubVI

All comments

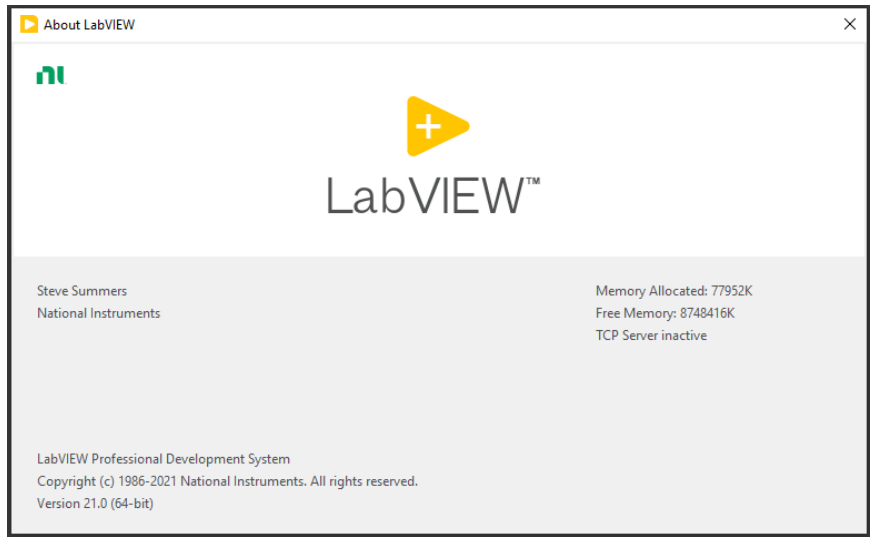
VI Hierarchy

LabVIEW Profile Tools

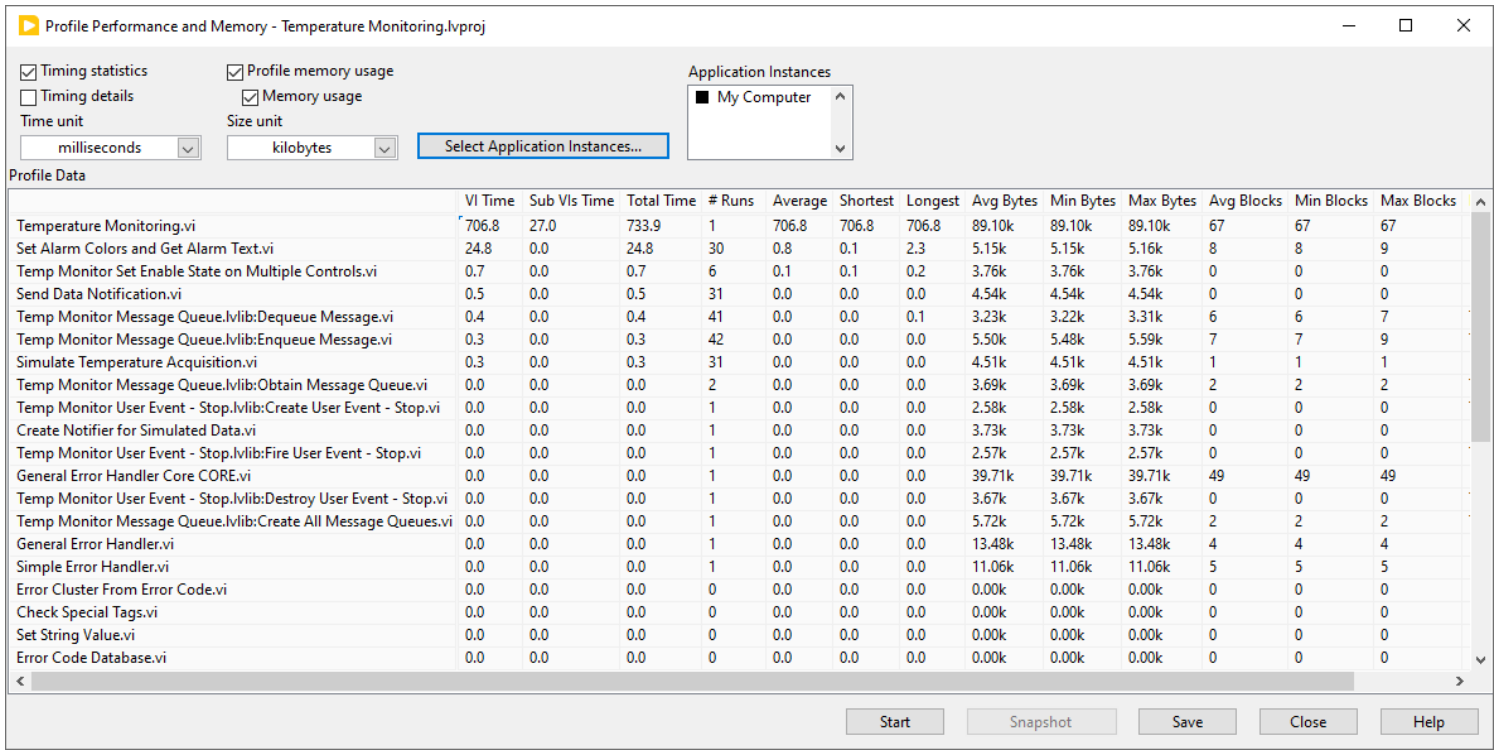


Free, included with all versions of LabVIEW

Memory Usage



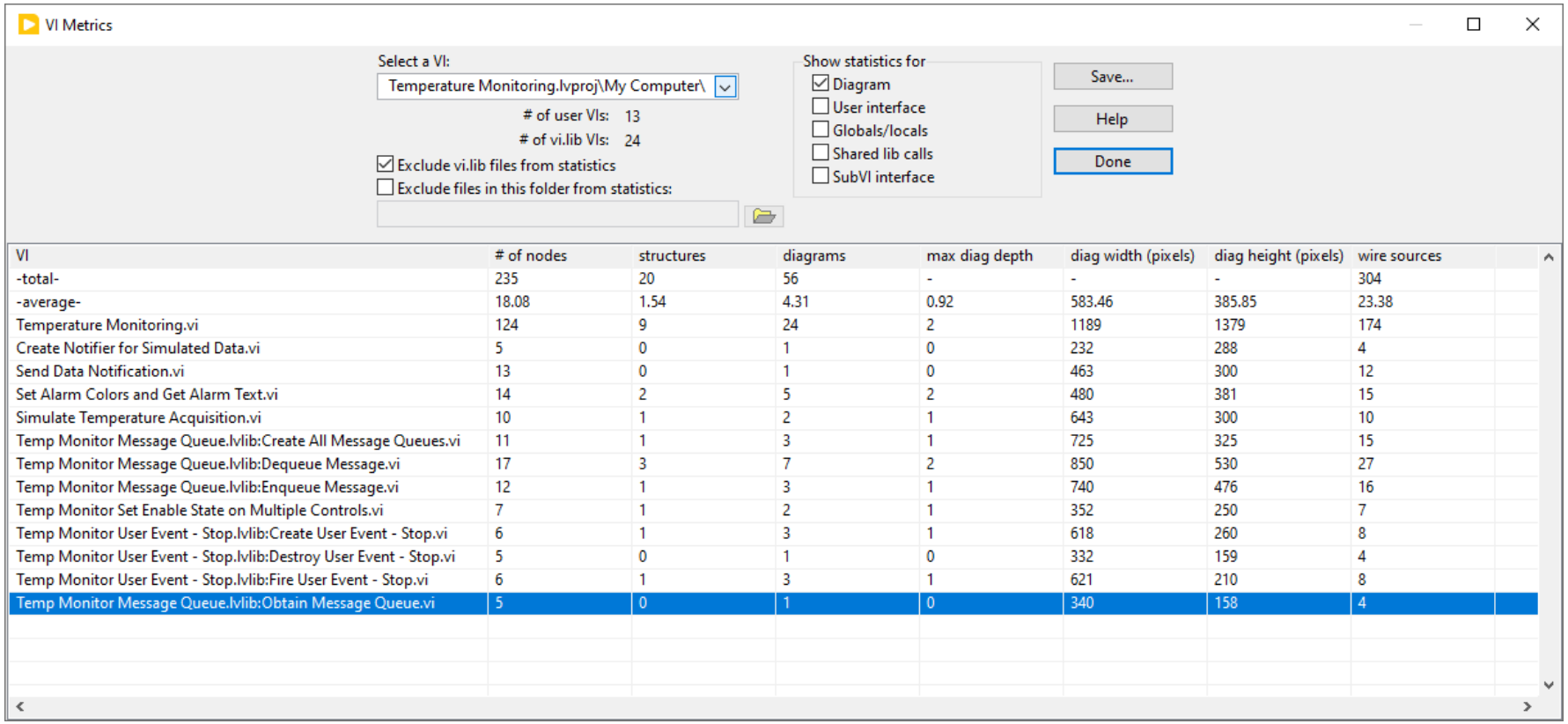
Help…About LabVIEW
Total allocated memory in use



	VI Time	Sub VIs Time	Total Time	# Runs	Average	Shortest	Longest	Avg Bytes	Min Bytes	Max Bytes	Avg Blocks	Min Blocks	Max Blocks
Temperature Monitoring.vi	706.8	27.0	733.9	1	706.8	706.8	706.8	89.10k	89.10k	89.10k	67	67	67
Set Alarm Colors and Get Alarm Text.vi	24.8	0.0	24.8	30	0.8	0.1	2.3	5.15k	5.15k	5.16k	8	8	9
Temp Monitor Set Enable State on Multiple Controls.vi	0.7	0.0	0.7	6	0.1	0.1	0.2	3.76k	3.76k	3.76k	0	0	0
Send Data Notification.vi	0.5	0.0	0.5	31	0.0	0.0	0.0	4.54k	4.54k	4.54k	0	0	0
Temp Monitor Message Queue.lvlib:Dequeue Message.vi	0.4	0.0	0.4	41	0.0	0.0	0.1	3.23k	3.22k	3.31k	6	6	7
Temp Monitor Message Queue.lvlib:Enqueue Message.vi	0.3	0.0	0.3	42	0.0	0.0	0.0	5.50k	5.48k	5.59k	7	7	9
Simulate Temperature Acquisition.vi	0.3	0.0	0.3	31	0.0	0.0	0.0	4.51k	4.51k	4.51k	1	1	1
Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	0.0	0.0	0.0	2	0.0	0.0	0.0	3.69k	3.69k	3.69k	2	2	2
Temp Monitor User Event - Stop.lvlib:Create User Event - Stop.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	2.58k	2.58k	2.58k	0	0	0
Create Notifier for Simulated Data.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	3.73k	3.73k	3.73k	0	0	0
Temp Monitor User Event - Stop.lvlib:Fire User Event - Stop.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	2.57k	2.57k	2.57k	0	0	0
General Error Handler Core CORE.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	39.71k	39.71k	39.71k	49	49	49
Temp Monitor User Event - Stop.lvlib:Destroy User Event - Stop.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	3.67k	3.67k	3.67k	0	0	0
Temp Monitor Message Queue.lvlib:Create All Message Queues.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	5.72k	5.72k	5.72k	2	2	2
General Error Handler.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	13.48k	13.48k	13.48k	4	4	4
Simple Error Handler.vi	0.0	0.0	0.0	1	0.0	0.0	0.0	11.06k	11.06k	11.06k	5	5	5
Error Cluster From Error Code.vi	0.0	0.0	0.0	0	0.0	0.0	0.0	0.00k	0.00k	0.00k	0	0	0
Check Special Tags.vi	0.0	0.0	0.0	0	0.0	0.0	0.0	0.00k	0.00k	0.00k	0	0	0
Set String Value.vi	0.0	0.0	0.0	0	0.0	0.0	0.0	0.00k	0.00k	0.00k	0	0	0
Error Code Database.vi	0.0	0.0	0.0	0	0.0	0.0	0.0	0.00k	0.00k	0.00k	0	0	0

Tools…Profile…Performance and Memory
Memory, time per VI and SubVI

VI Metrics



VI	# of nodes	structures	diagrams	max diag depth	diag width (pixels)	diag height (pixels)	wire sources
-total-	235	20	56	-	-	-	304
-average-	18.08	1.54	4.31	0.92	583.46	385.85	23.38
Temperature Monitoring.vi	124	9	24	2	1189	1379	174
Create Notifier for Simulated Data.vi	5	0	1	0	232	288	4
Send Data Notification.vi	13	0	1	0	463	300	12
Set Alarm Colors and Get Alarm Text.vi	14	2	5	2	480	381	15
Simulate Temperature Acquisition.vi	10	1	2	1	643	300	10
Temp Monitor Message Queue.lvlib:Create All Message Queues.vi	11	1	3	1	725	325	15
Temp Monitor Message Queue.lvlib:Dequeue Message.vi	17	3	7	2	850	530	27
Temp Monitor Message Queue.lvlib:Enqueue Message.vi	12	1	3	1	740	476	16
Temp Monitor Set Enable State on Multiple Controls.vi	7	1	2	1	352	250	7
Temp Monitor User Event - Stop.lvlib:Create User Event - Stop.vi	6	1	3	1	618	260	8
Temp Monitor User Event - Stop.lvlib:Destroy User Event - Stop.vi	5	0	1	0	332	159	4
Temp Monitor User Event - Stop.lvlib:Fire User Event - Stop.vi	6	1	3	1	621	210	8
Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	5	0	1	0	340	158	4

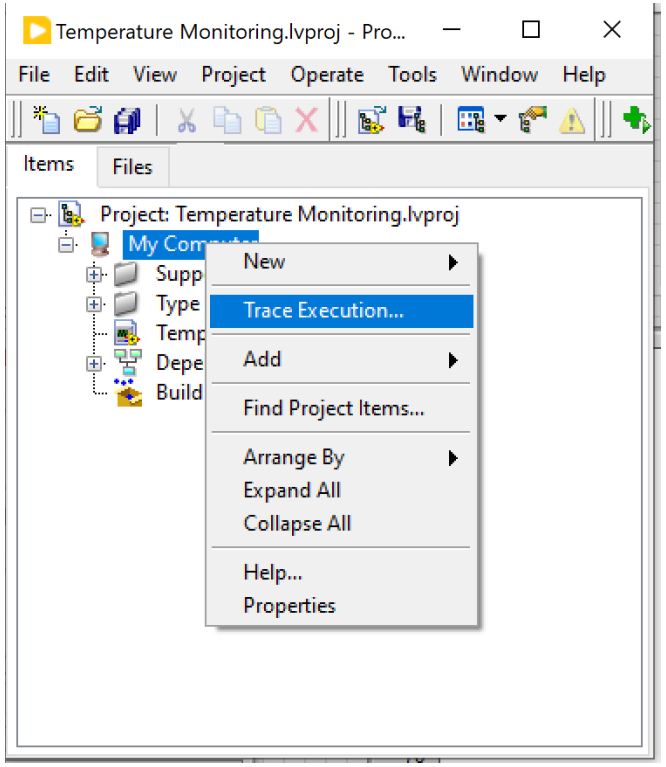
Tools…Profile…VI Metrics

Track code complexity

Track code changes over time

Desktop Execution Trace Toolkit

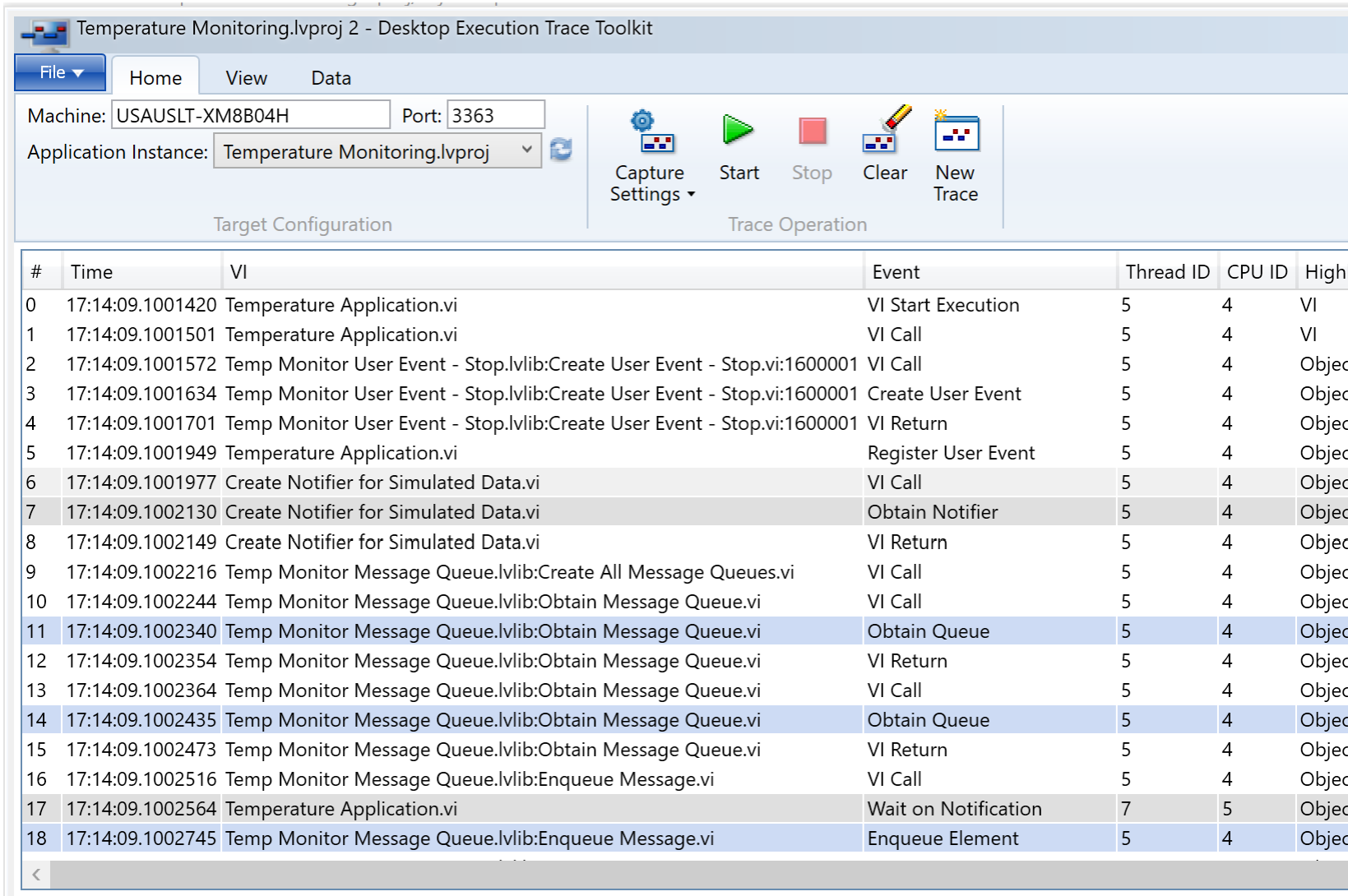
Included with Professional; separate install



Trace Execution…

Get details of program execution

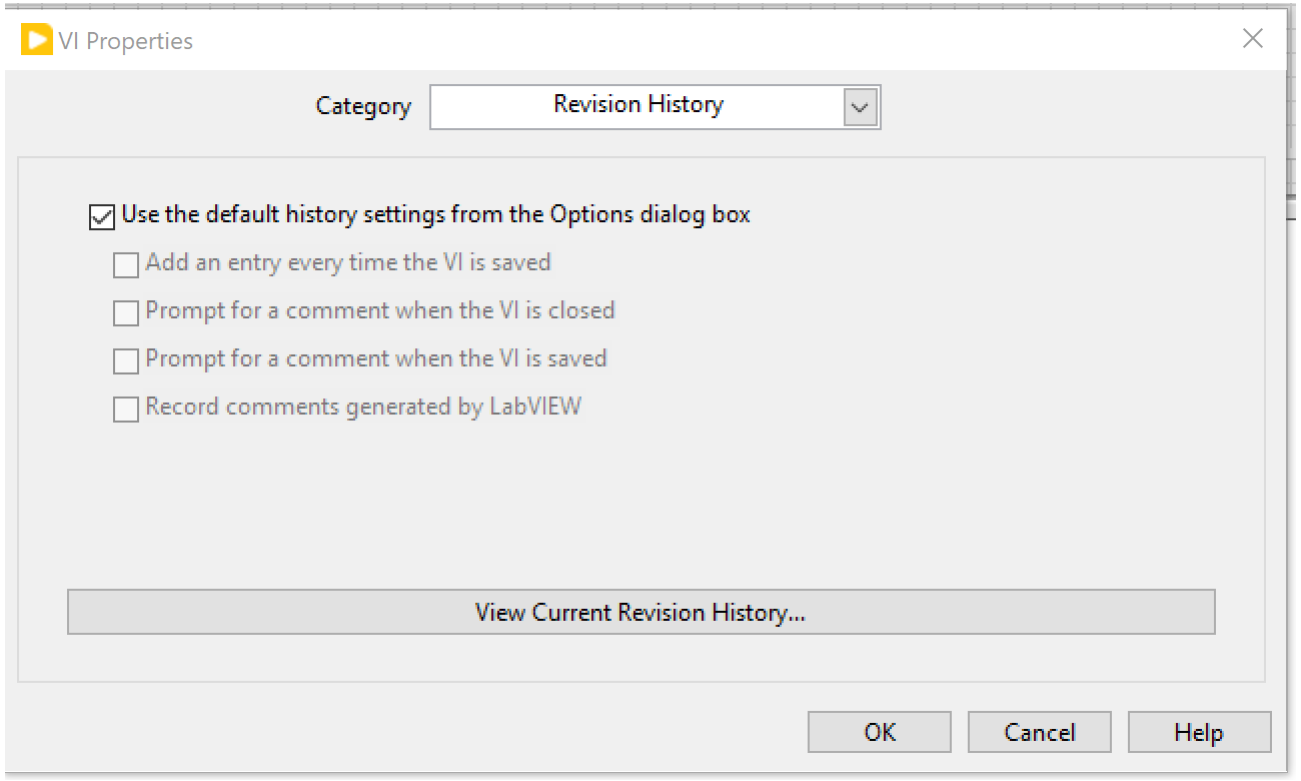
Look for unapproved actions

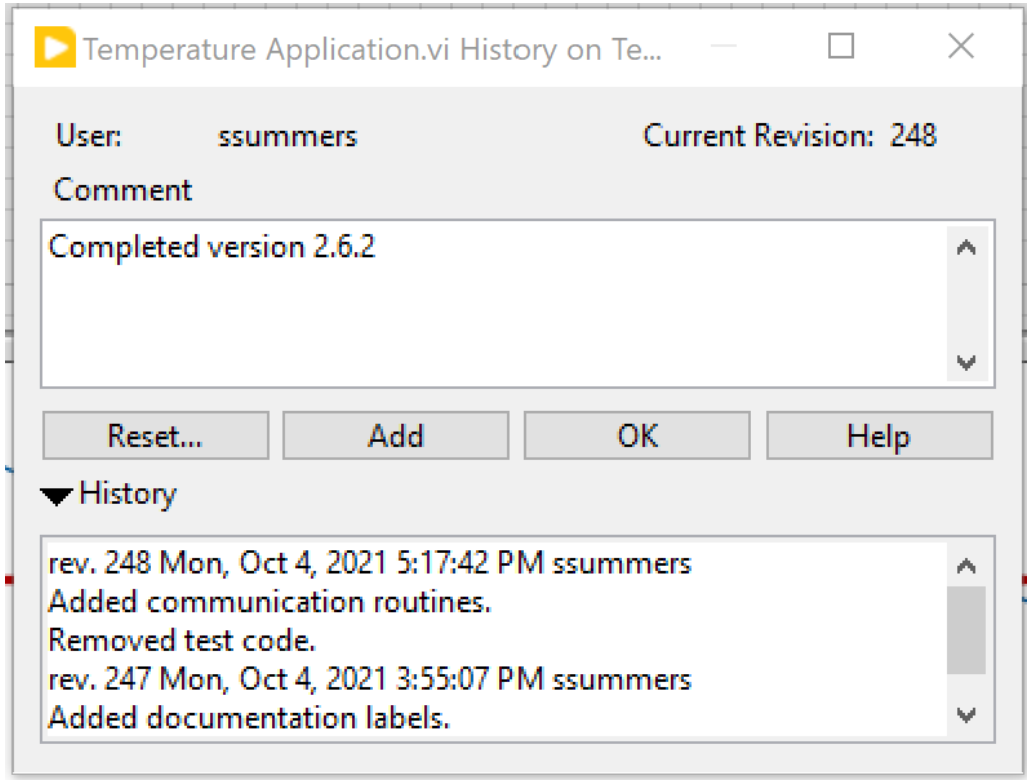


#	Time	VI	Event	Thread ID	CPU ID	High
0	17:14:09.1001420	Temperature Application.vi	VI Start Execution	5	4	VI
1	17:14:09.1001501	Temperature Application.vi	VI Call	5	4	VI
2	17:14:09.1001572	Temp Monitor User Event - Stop.lvlib:Create User Event - Stop.vi:1600001	VI Call	5	4	Objec
3	17:14:09.1001634	Temp Monitor User Event - Stop.lvlib:Create User Event - Stop.vi:1600001	Create User Event	5	4	Objec
4	17:14:09.1001701	Temp Monitor User Event - Stop.lvlib:Create User Event - Stop.vi:1600001	VI Return	5	4	Objec
5	17:14:09.1001949	Temperature Application.vi	Register User Event	5	4	Objec
6	17:14:09.1001977	Create Notifier for Simulated Data.vi	VI Call	5	4	Objec
7	17:14:09.1002130	Create Notifier for Simulated Data.vi	Obtain Notifier	5	4	Objec
8	17:14:09.1002149	Create Notifier for Simulated Data.vi	VI Return	5	4	Objec
9	17:14:09.1002216	Temp Monitor Message Queue.lvlib:Create All Message Queues.vi	VI Call	5	4	Objec
10	17:14:09.1002244	Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	VI Call	5	4	Objec
11	17:14:09.1002340	Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	Obtain Queue	5	4	Objec
12	17:14:09.1002354	Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	VI Return	5	4	Objec
13	17:14:09.1002364	Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	VI Call	5	4	Objec
14	17:14:09.1002435	Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	Obtain Queue	5	4	Objec
15	17:14:09.1002473	Temp Monitor Message Queue.lvlib:Obtain Message Queue.vi	VI Return	5	4	Objec
16	17:14:09.1002516	Temp Monitor Message Queue.lvlib:Enqueue Message.vi	VI Call	5	4	Objec
17	17:14:09.1002564	Temperature Application.vi	Wait on Notification	7	5	Objec
18	17:14:09.1002745	Temp Monitor Message Queue.lvlib:Enqueue Message.vi	Enqueue Element	5	4	Objec

Protect Code Development

Revision History





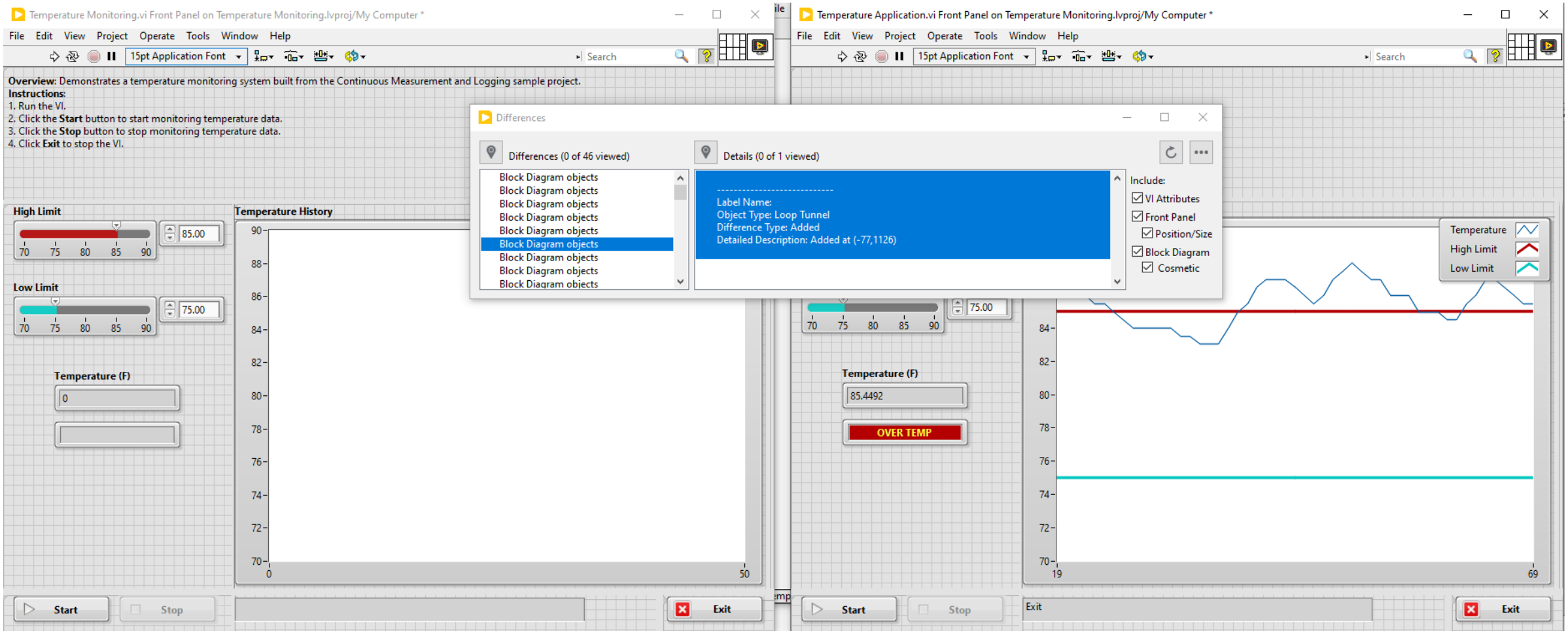
VI Properties…Revision History

Configure VI to require revision comments

View revision history

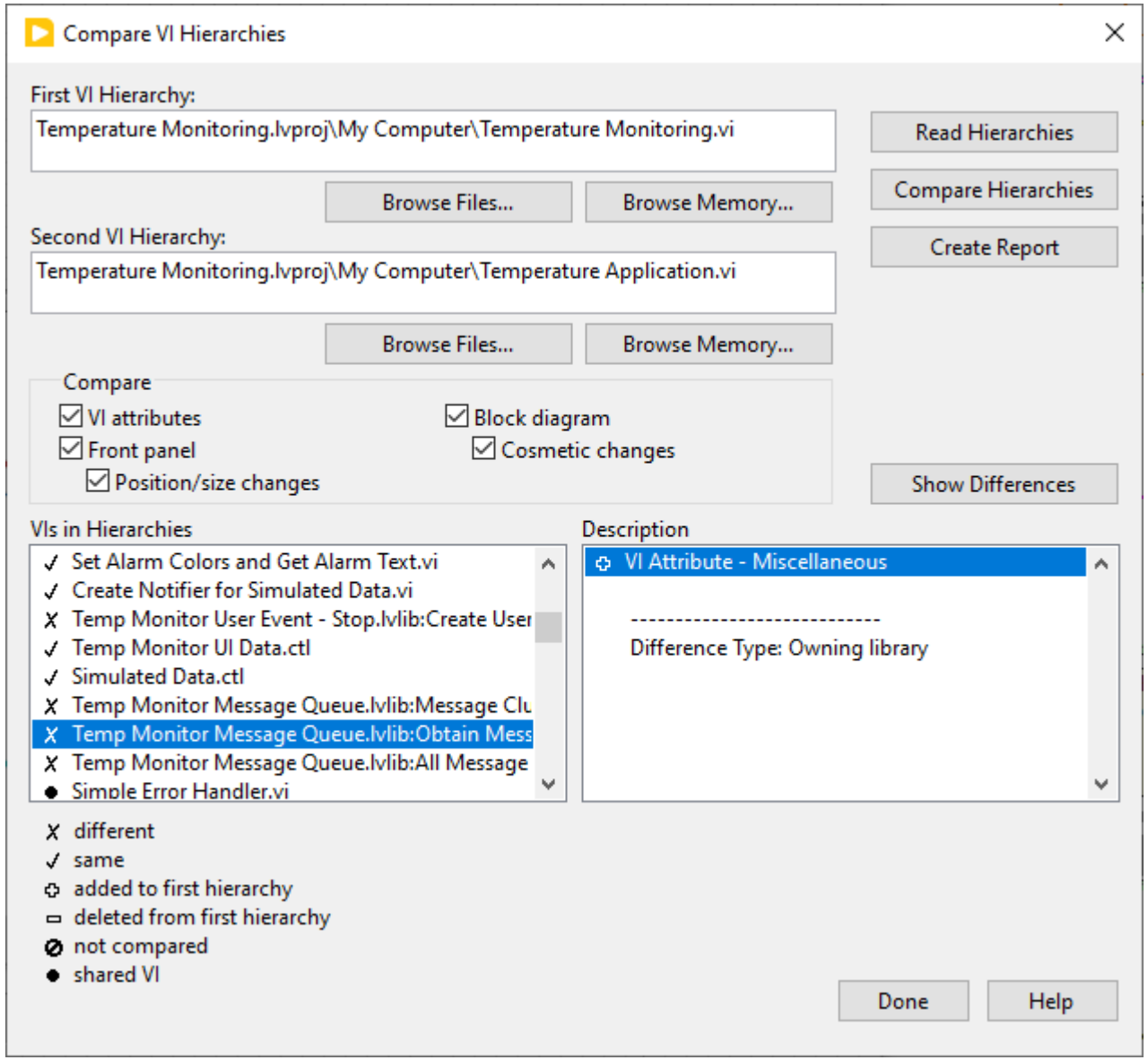
Compare LabVIEW Versions

Tools…Compare…Compare VIs



Compare LabVIEW Versions

Tools…Compare…Compare VI Hierarchies



Verify Code Performance

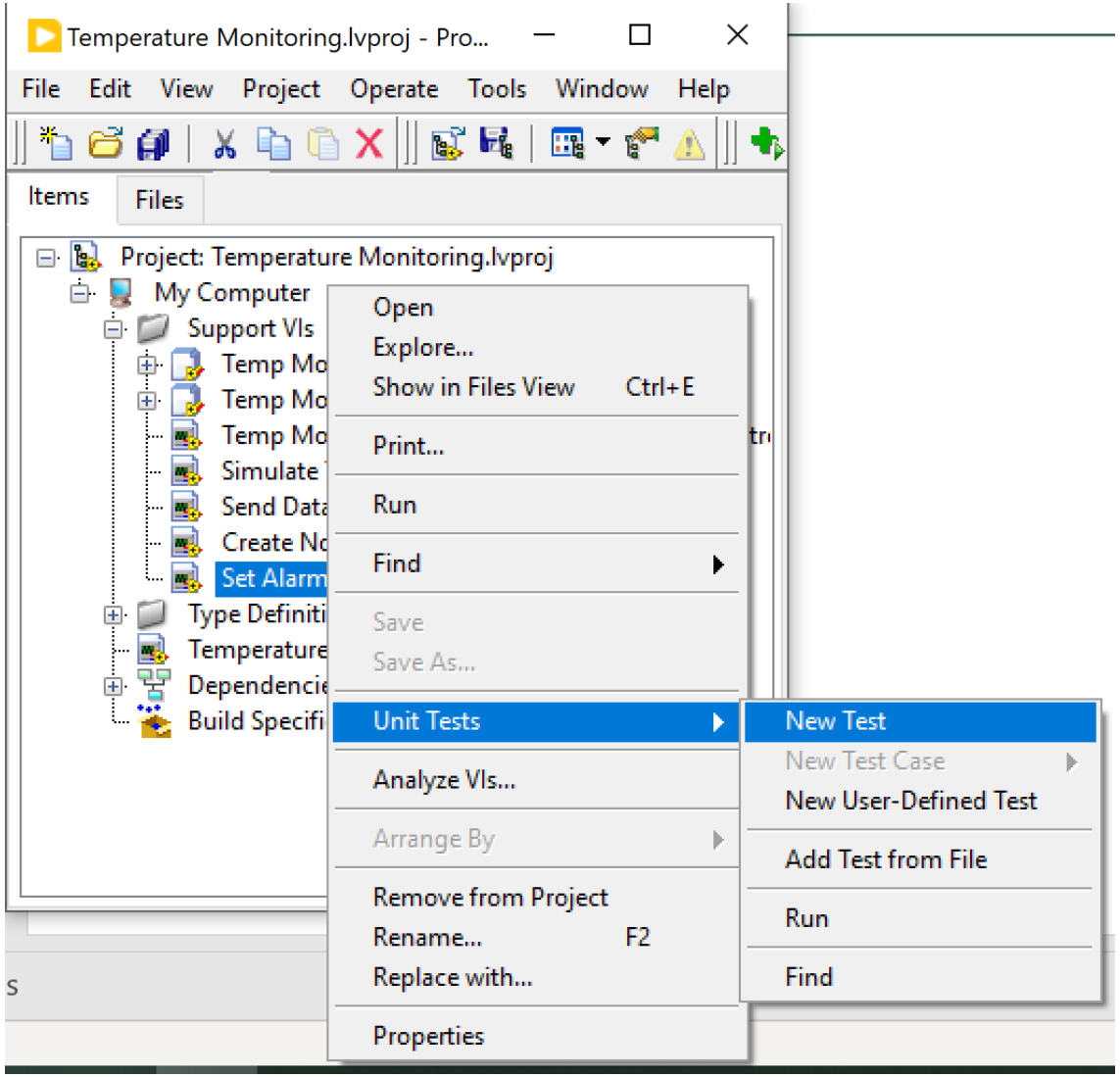
Unit Test Framework

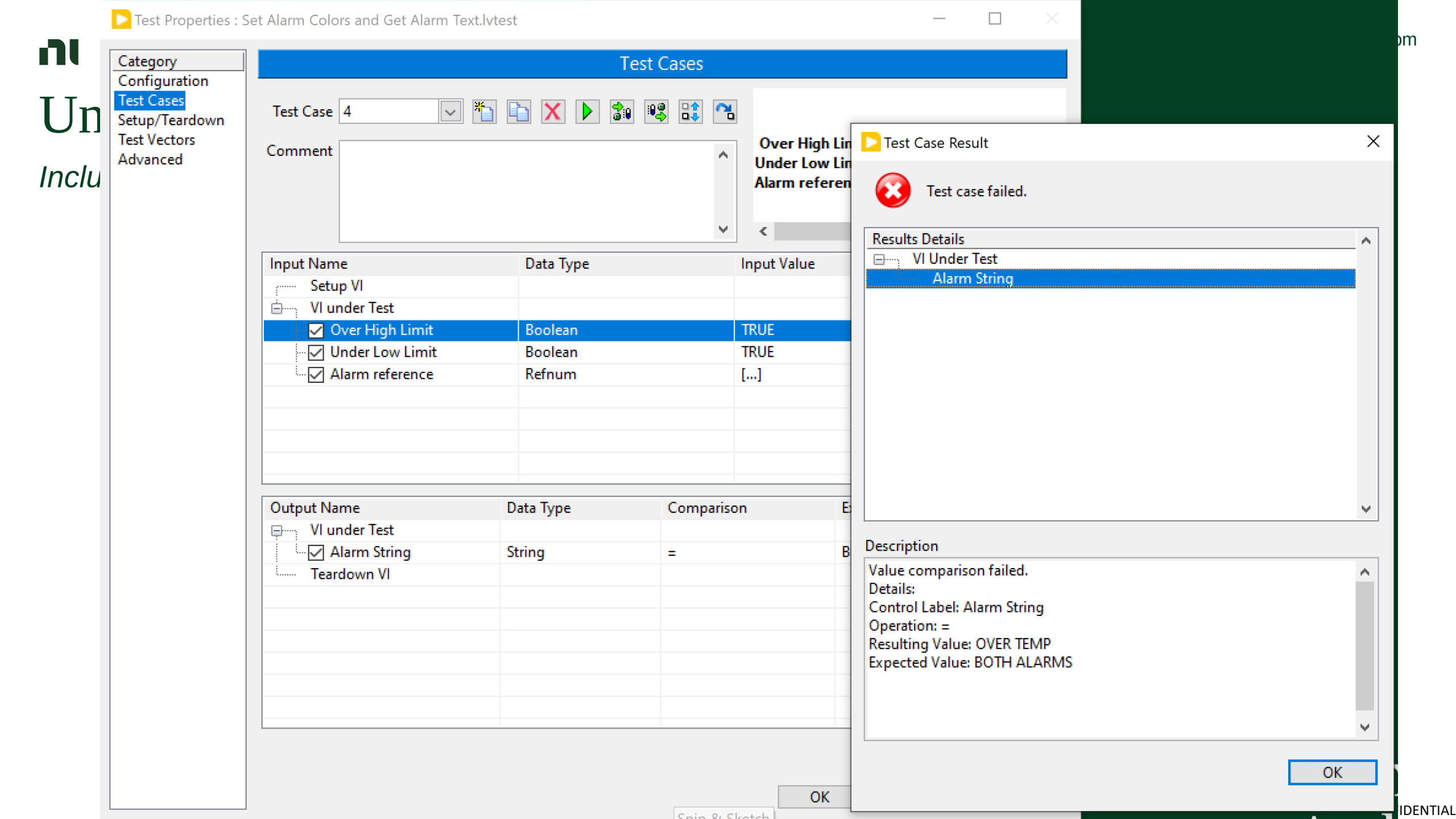
Included with Professional; separate install

Project Window…Code…Unit Tests

Define Inputs, Expected Outputs for various test cases

Cascade to test code modules and hierarchies

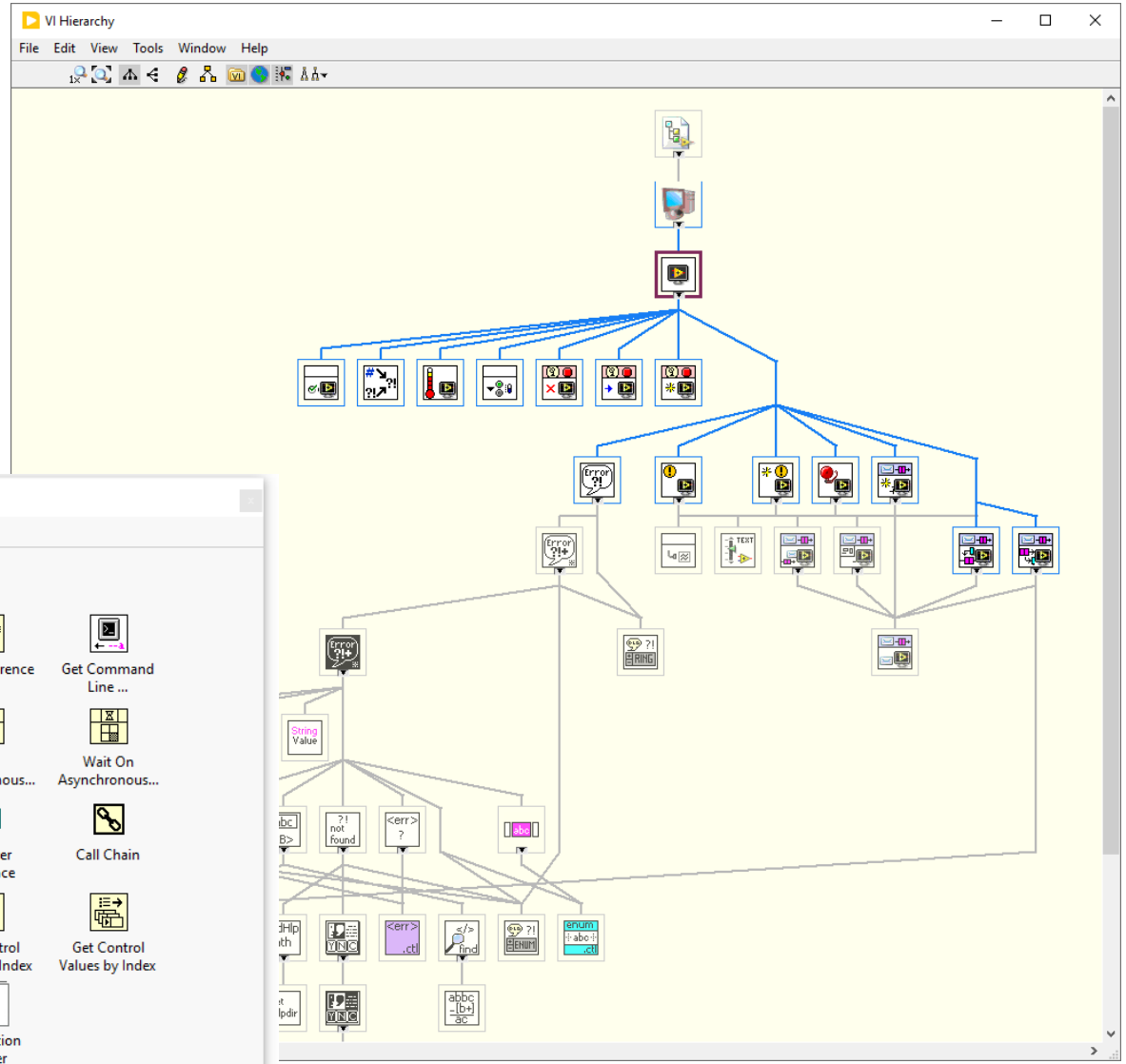


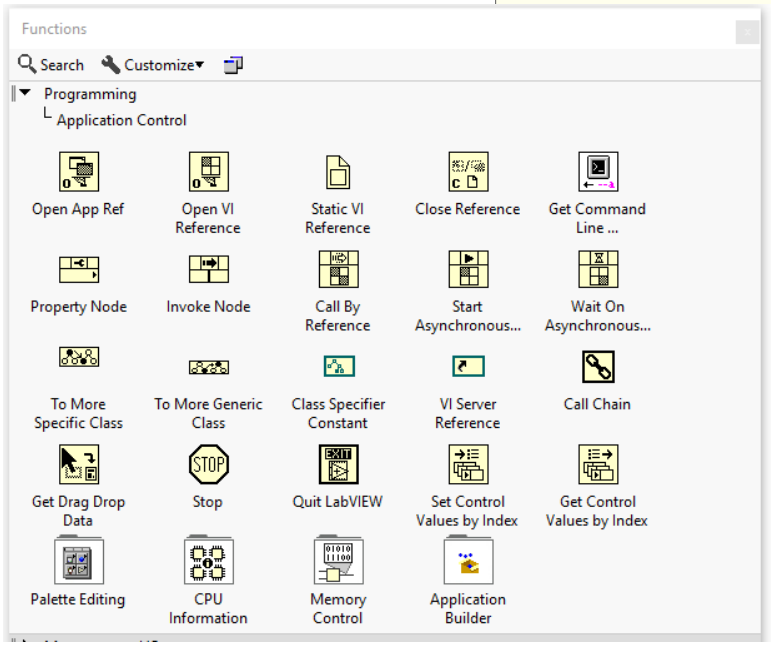

Test Properties : Set Alarm Colors and Get Alarm Text.lvtest
Category
Configuration
Test Cases
Setup/Teardown
Test Vectors
Advanced
Test Cases
Test Case 4
Comment
Over High Lim
Under Low Lim
Alarm referen
Input Name
Data Type
Input Value
Setup VI
VI under Test
Over High Limit
Boolean
TRUE
Under Low Limit
Boolean
TRUE
Alarm reference
Refnum
[...]
Output Name
Data Type
Comparison
VI under Test
Alarm String
String
=
Teardown VI
OK
Test Case Result
Test case failed.
Results Details
VI Under Test
Alarm String
Description
Value comparison failed.
Details:
Control Label: Alarm String
Operation: =
Resulting Value: OVER TEMP
Expected Value: BOTH ALARMS
OK

LabVIEW Static Code Analysis – Manual Search

VIEW…VI Hiearchy
See all functions being called

Review for VI calls of secure functions
- Open Ports
- Communication VIs (TCP, UDP)
- Encryption VIs
- Application Control VIs
- Command Line Interface

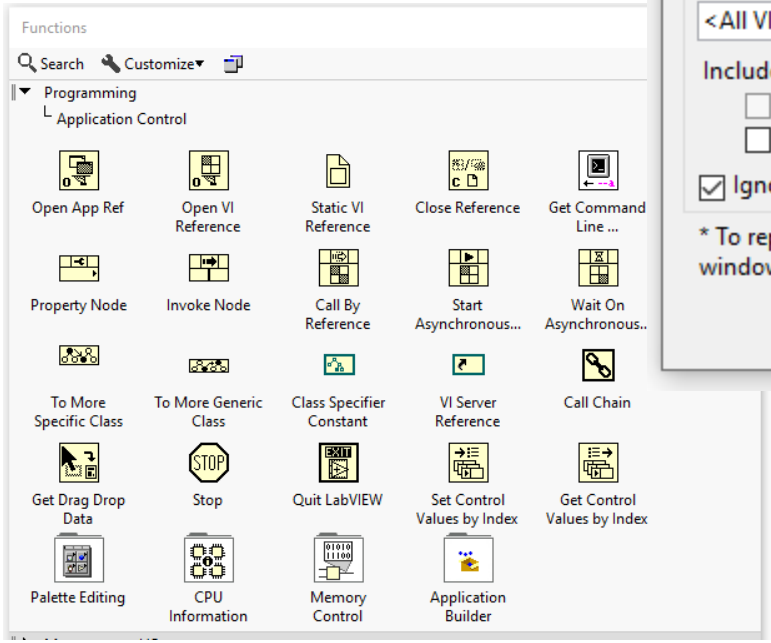


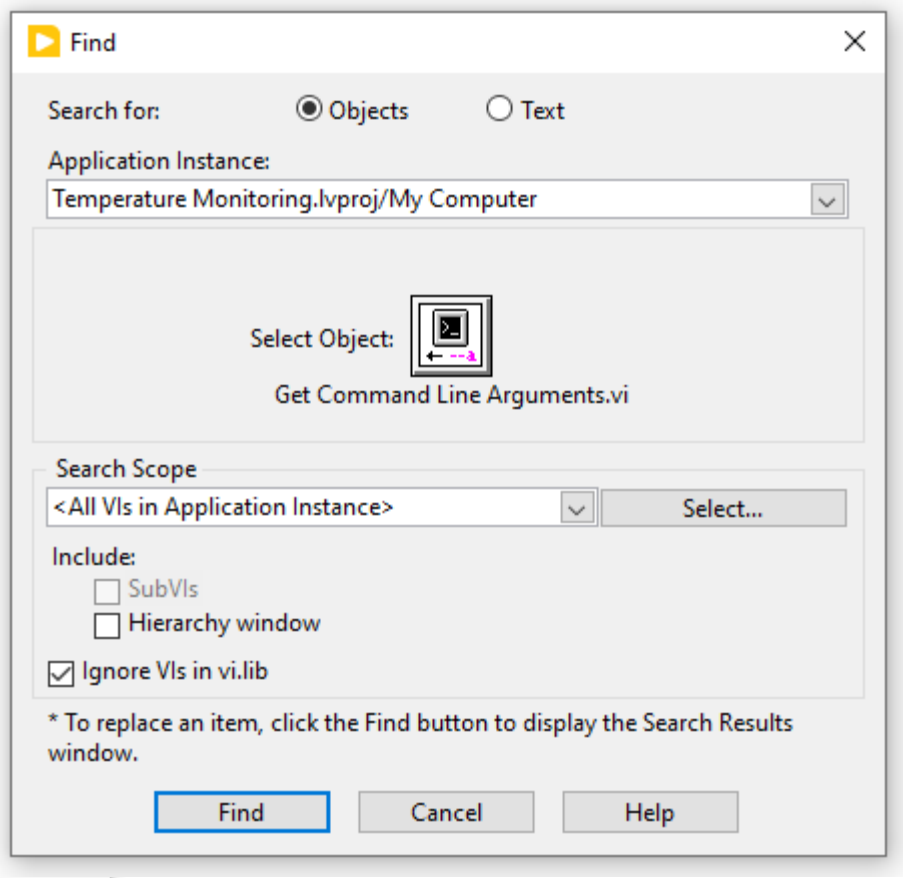


LabVIEW Static Code Analysis – LabVIEW Search

Edit…Find and Replace
Search for functions within a VI heirarchy

Search for VI calls of secure functions
- Open Ports
- Communication VIs (TCP, UDP)
- Encryption VIs
- Application Control VIs
- Command Line Interface





LabVIEW Static Code Analysis - VI Analyzer

Included with Professional; separate install

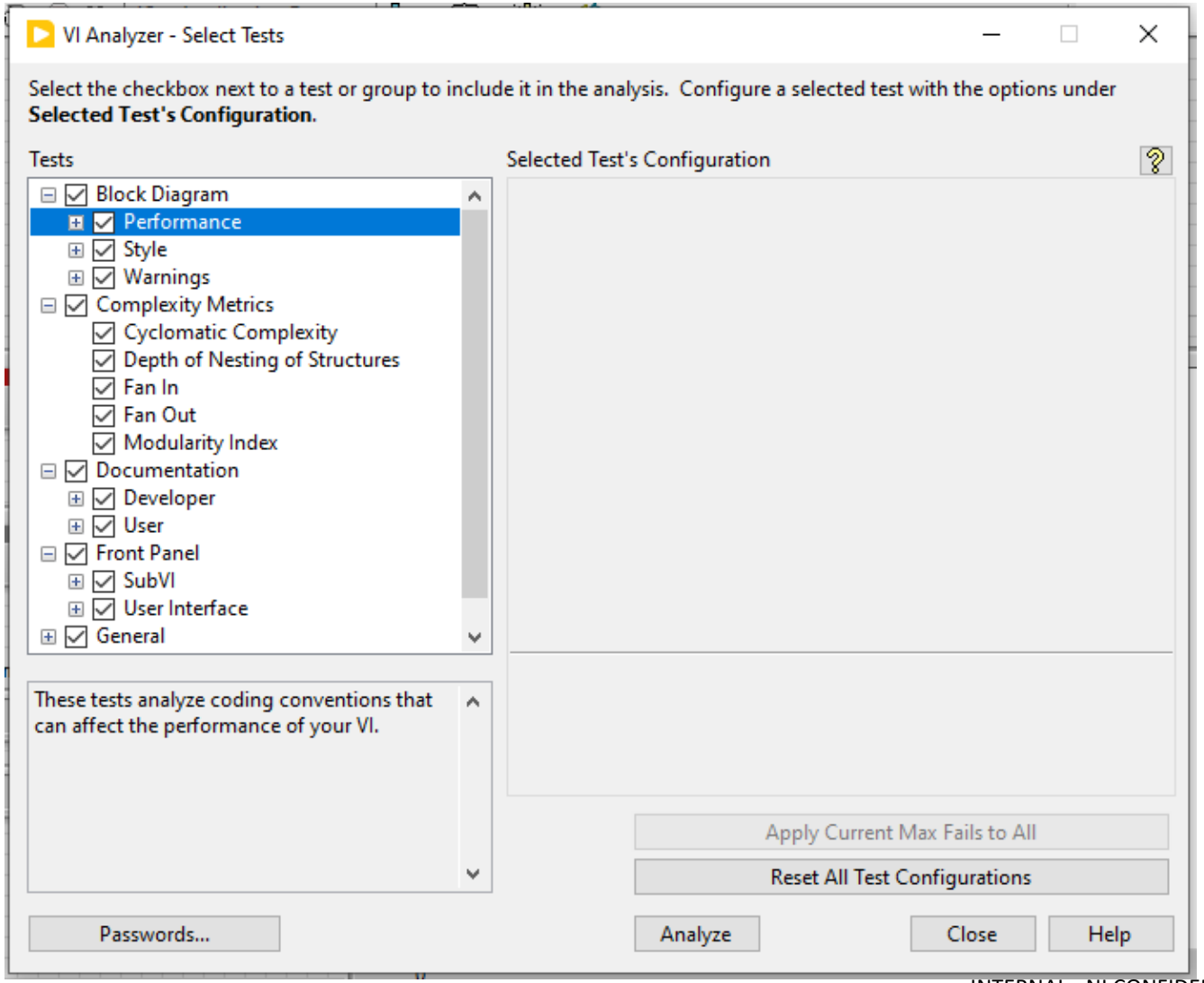
ni.com/vianalyzer

Tools…Analyze Vis
Interactive or programmatic execution

Static code analysis
- Checks style compliance
- Identifies performance issues
- Finds bugs

Select built-in tests to run
Create custom tests to run

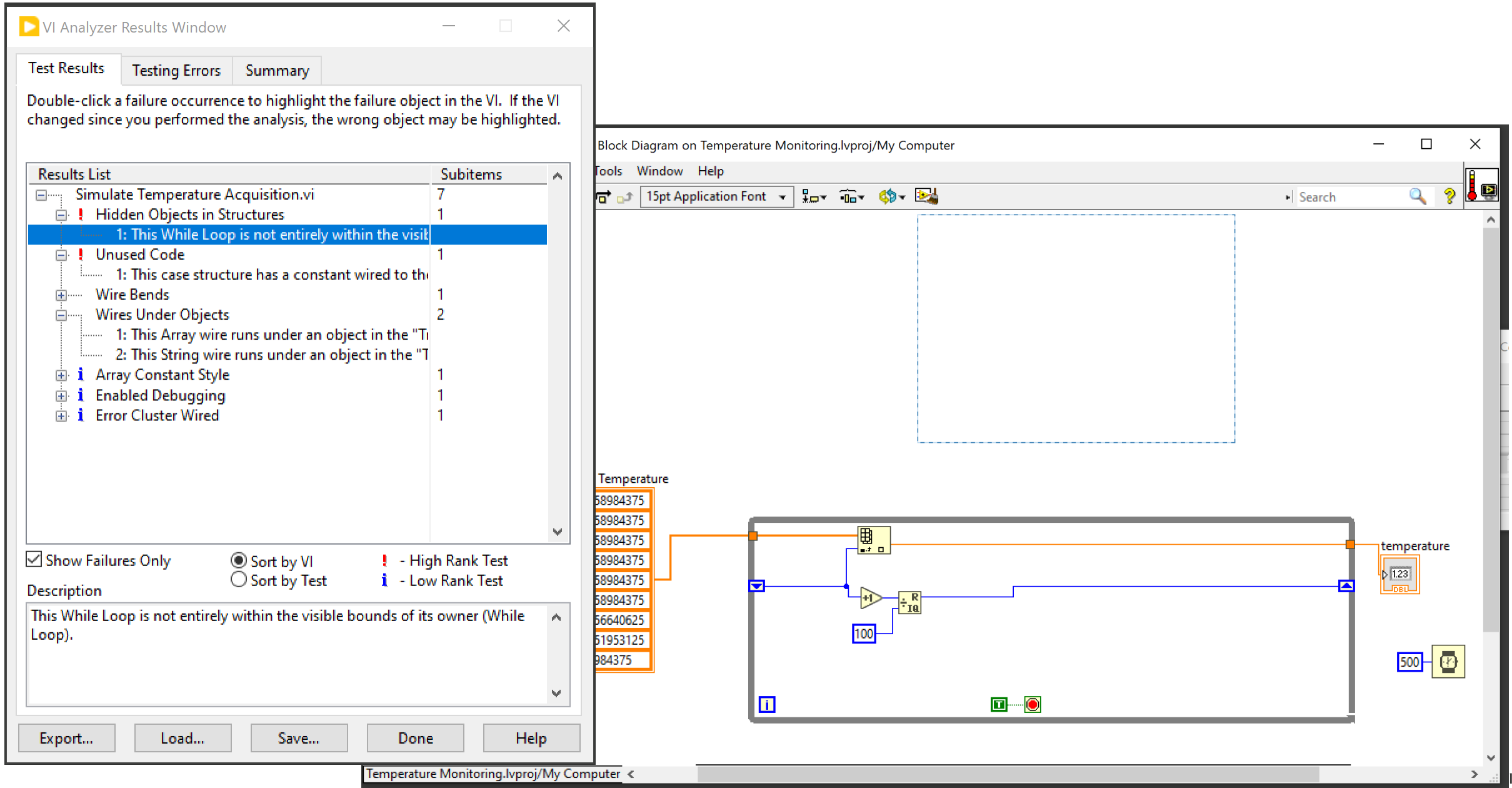
VI Analyzer Enthusiasts group maintains repository of custom tests



LabVIEW Static Code Analysis - VI Analyzer

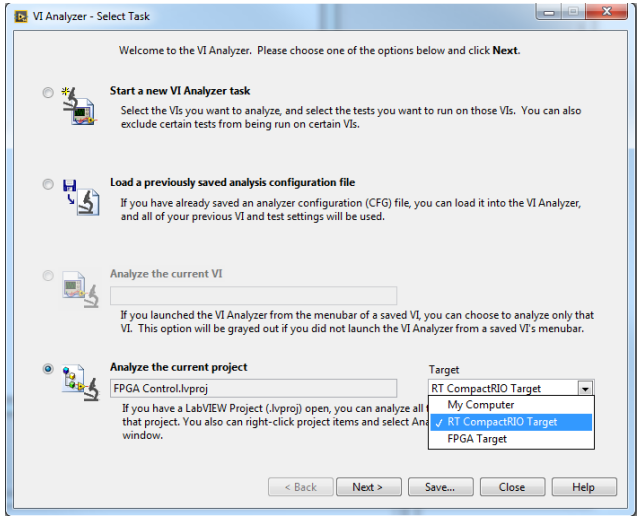
ni.com

ni.com/vianalyzer

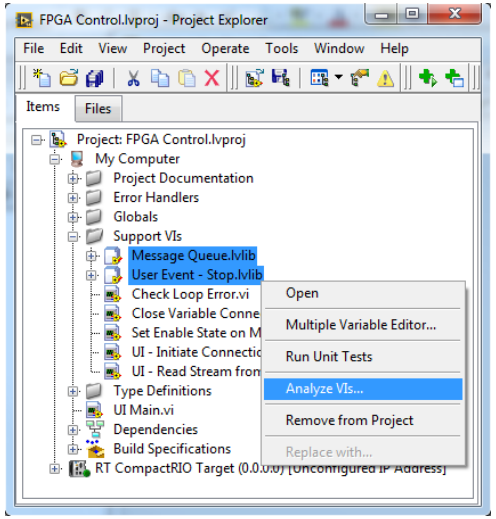


Using LabVIEW VI Analyzer for Security Tests

Run VI Analyzer from the project window to analyze all VIs contained in a project



or

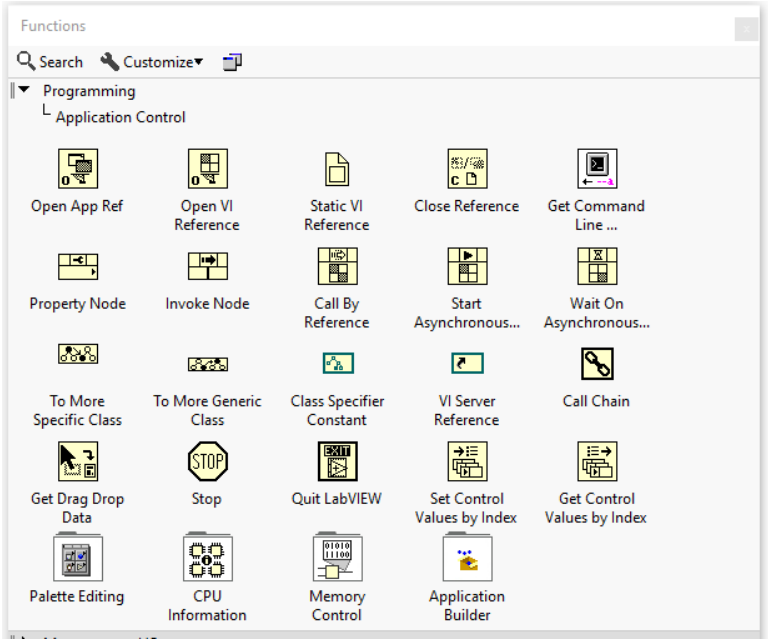


Using LabVIEW VI Analyzer for Security Tests

- The **VI Analyzer Test Creator** allows you to create your own tests that plug in to the VI Analyzer

- The Test Creator is a feature of the VI Analyzer Toolkit

- Configure to look for secure functions
  - Open Ports
  - Communication VIs (TCP, UDP)
  - Encryption VIs
  - Application Control VIs
  - Command Line Interface



- For instructions on how to set up custom tests:

https://zone.ni.com/reference/en-XX/help/371361R-01/lvvianalyzerhelp/writing_vian_test/

Validate Code Usage

File Integrity Monitoring

Available from third-party sources

Once built into applications, LabVIEW files are managed the same as any other application

FIM tools can detect files that have been altered, updated, or compromised

A complete FIM strategy monitors:
- User-built LabVIEW applications
- Configuration files
- LabVIEW run-time engine files

FIM tools monitor properties of files, including:
- Created, modified, and accessed settings and permissions
- Security and privilege settings
- Content of the file
- Core attributes and size
- Hash values, based on file contents
- Configuration values
- Credentials

Thank you…

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